THE

ONTARIO WATER RESOURCES

COMMISSION

GROUND WATER SURVEY

REGIONAL MUNICIPALITY

OF

OTTAWA-CARLETON

1970

REPORT

Ontario Water Resources Commission

Municipality: Regional Municipality of Ottawa-Carleton Date of Inspection: October, 1969.

Re: Ground Water Survey

Field Inspection by: A. A. Sobanski, S. F. Sisson Report by: A. A. Sobanski, P. Eng.

INTRODUCTION

At the request of Mr. D. M. Coolican, Chairman, The Regional Municipality of Ottawa-Carleton, a ground-water survey of the entire regional municipality was conducted by the Division of Water Resources. The purpose of the study was to establish areas, generally beyond the greenbelt, where ground water is available in amounts sufficient for municipal purposes.

The report provides a summary of the work carried out during the investigation. It includes discussions on the hydrogeologic characteristics of the aquifers and their relation to ground-water availability, the chemical water quality, the ground-water recharge potential, the ground-water pollution potential, brief ground-water surveys for 24 municipalities within the study area, and recommendations on the development of water supplies.

Figures are presented from which the geology, aquifer distribution, chemical water quality, and probable well yields from various aquifers can be derived. Within the limitations expressed herein, these figures can be used to

design test-drilling programs in areas of interest.

This work was co-ordinated, at various times, with the consulting engineering firm, James F. MacLaren Limited, which undertook a statistical study of well data to determine the general ground-water conditions in the area.

Survey Data

The Regional Municipality of Ottawa-Carleton comprises the County of Carleton and the Township of Cumberland, an area of 1,064 square miles.

Of the more than 10,000 water-well records on file with the Division of Water Resources for the study area, the records of about 1,800 drilled, private, municipal and test wells were used to determine the prevailing hydrogeologic conditions. The well records utilized are not presented but are available for perusal in the offices of the Division of Water Resources. The well numbering system used in this report relates to the permanent coding numbers of the OWRC.

Information on the geologic and hydrologic conditions is available in various publications. In the course of the report, reference is made to pertinent publications used in the study. A selected reference list accompanies the report.

In the field, officials were interviewed and a brief hydrogeologic reconnaissance survey was conducted. Water samples were collected to determine the general chemical characteristics of the ground water in the study area, particularly in the vicinity of municipalities which could eventually require a municipal water-supply system.

GEOLOGY AND DESCRIPTION OF AQUIFERS

Bedrock

The bedrock comprises granitic and metasedimentary rocks of Precambrian age and sedimentary sandstones, dolomites, limestones, and shales of Cambrian and Ordovician age. The bedrock formations, their lithologies and maximum thicknesses are summarized on Page 4. Formation thicknesses are highly variable because of faulting and inter- and post-depositional erosion.

Post-Ordovician faulting and subsequent erosion have produced the complex bedrock configuration shown in Figure 3. The sedimentary strata have no general direction of dip and strike. In much of the area, the rocks are flat-lying or gently undulating. The beds are tilted at various angles in the fault blocks and near the principal faults. Figures 1 and 2 show generalized cross-sections of the subsurface geology.

BEDROCK STRATIGRAPHY OF THE OTTAWA-CARLETON AREA

PERIOD	SUB-EPOCH		FORMATION	LITHOLOGY	MAXIMUM THICKNESS (feet)
UPPER ORDOVICIAN	Richmond		Queenston Russell	Red shale Grey shale, interbedded, dolomite	100
	Lorraine		Carlsbad	Grey shale	550
	Gloucester and Collingwood		Billings	Black shale	300
			Eastview	Limestone	20
			DISCONFORMITY		
MIDDLE ORDOVICIAN	Trenton	OTTAWA	Cobourg Sherman Falls Hull Rockland	Limestone	750
	Black River	OTTAWA	Leray Lowville Pamelia		
			DISCONFORMITY		
	Chazy		St. Martin Rockcliffe	Limestone Interbedded sandstone and shale	200
			DISCONFORMITY		
LOWER ORDOVICIAN	Beekmantown		Oxford March	Dolomite Interbedded sandstone and dolomite	350
UPPER CAMBRIAN			Nepean	Sandstone	850+
			GREAT UNCONFORMITY		
PRECAMBRIAN				Granitic and metasedimentary complex	

The contacts between the formations shown in Figure 3 have not been significantly altered to consider the effects of bedrock topography, as data on formation attitudes are sparse, or to conform with drillers' lithologic descriptions as they often lack consistency.

Figure 5 shows an interpretation of the shape of the bedrock surface derived from topographic maps, reported areas of bedrock outcrop, and water-well records. The bedrock surface in the southern half of the study area is gently undulating and slopes from west to east, from an elevation of about 500 feet above sea level to an elevation of about 200 feet above sea level. The northern half of the area is characterized by deep depressions, which incise the bedrock below the valleys of Carp River, Constance Creek, Ottawa River, and Mer Bleue Peat Bog. The depressions are frequently associated with faults and likely have been formed by glacial and fluvial erosion.

The area is traversed by many major and minor fault systems which have significantly affected the distribution of the bedrock aquifers. The two major fault zones are the Gloucester and the Hazeldean. In the fault block west of the Gloucester fault, good aquifers in the Oxford and Nepean formations have been uplifted about 1,500 feet into contact with poor aquifers in the Queenston and Carlsbad formations east of the fault.

Differences in ground-water quality on either side of the Gloucester fault indicate that the fault is hydraulically sealed. Investigators have reported that other faults in the area are sealed.[1, 11, 15, 18]

In the bedrock, ground water moves mainly through openings of limited size such as fractures, joints, and bedding planes. Flow may also occur through connected, intergranular porosity in sandstone aquifers and possibly in reefal zones in carbonate aquifers. Ground water moves under the influence of gravity from topographically high areas toward discharge in the topographically low valleys of rivers, creeks and swamps.

To delineate trends of better aquifer development and to evaluate the aquifer characteristics of the various geologic formations, drillers' records were studied, particularly the records of wells tested at high pumping rates. Maps of specific capacity and theoretical yield were prepared, based on short-term and long-term pumping tests conducted by drillers. Specific capacity, which is the well yield in gallons per minute per foot of drawdown, is a measure of the ability of a well to yield water. Theoretical yield is the product of the specific capacity of a well and its available drawdown. To allow for declining specific capacity with time due to the lowering of water levels in

wells by pumping, the effects of negative boundaries, and the effects of turbulent losses which can cause disproportionate drawdowns at larger pumping rates in bedrock wells, the theoretical well yields were reduced by a factor of three.

Analysis of the data did not define discernable permeability trends. The distribution of highly permeable zones in the bedrock formations is extremely variable. Wells with large and small specific capacities and theoretical yields are frequently found in close proximity. The amount of water available from any well appears to depend on the jointing and bedding of the local rock and the number and size of the bedding planes and/or solution channels which the well intersects.

In the carbonate aquifers, wells with larger theoretical yields appear to be more abundant in discharge areas. This observation was not tested statistically; however, greater enlargement of bedding planes and fractures by solution may occur in discharge areas where ground-water velocities are large. [4]

The following summarizes the aquifer potential of the bedrock formations in the Ottawa-Carleton area.

Precambrian

Characteristically, the permeability of Precambrian rocks is small. Specific capacities of wells are commonly less than 0.1 gpm per foot of drawdown and theoretical yields are generally less than 10 gpm. In general, drilling to great depth in the Precambrian will not significantly increase the well yield.

Nepean Formation

The Nepean sandstone is the best large-capacity bedrock aquifer in the study area. Specific capacities of wells vary from 0.1 to about 14 gpm per foot of drawdown and average about 3.5 gpm per foot of drawdown. Based on larger diameter wells, about 70 per cent of wells that penetrate 100 feet or more of the Nepean formation will yield in excess of 100 gpm.

The Nepean formation is essentially unexplored, except in the area that lies roughly between the Gloucester and Hazeldean faults. In the large south-central portion of the study area, in which the bedrock generally comprises dolomites of the Oxford formation, the aquifer potential of the Nepean formation is postulated to be excellent, from three widely separated municipal and test wells. Well 7364, near Greely, is 160 feet deep and obtains supplies from 13 feet

of Nepean sandstone. The well produced 300 gpm with about 30 feet of drawdown during a 24-hour test. A recently drilled test well at Munster is 380 feet deep and obtains supplies from 82 feet of Nepean sandstone. The well produced 150 gpm with a stabilized drawdown of 87 feet during a 55-hour test. Well 24-1237, at Kemptville, is 221 feet deep and obtains supplies mainly from 61 feet of the Nepean formation. The well produced 300 gpm with about 100 feet of drawdown during a 48-hour test.

In the northwest along Constance Creek, and along the Ottawa River to the east of Orleans, the Nepean aquifer lies at relatively shallow depth beneath other rock formations. The yield characteristics of the aquifer in these areas is unknown but, based on other areas, may be good.

Brandon[1] has reported that the Nepean aquifer is best developed near the top and base of the formation. However, drillers' logs indicate that aquifer zones are present throughout the Nepean section. In general, it appears that more fractures and joints, with a resulting increase in yield, will be encountered as a well penetrates deeper into the Nepean formation.

In some areas, the Nepean formation may be thin because of local highs in the Precambrian surface on which the sandstone was deposited. The area near Dunrobin can be cited as an example.

Where the Nepean formation lies at great depth, as in the City of Ottawa and east of the Gloucester fault, the yield from the aquifer is generally small, perhaps due to sealed faults and/or compaction of the fractures by the weight of overlying sediments.

March and Oxford Formations

The March formation is difficult to distinguish in the drillers' logs from either the underlying Nepean formation or the overlying Oxford formation. For purposes of this report, the March and Oxford formations are considered to be a hydrogeologic unit.

Aquifer development in the Oxford formation is highly variable. Theoretical yields of wells vary from less than 10 gpm to greater than 100 gpm. A few deep, dry holes have been drilled in the formation. Wells of apparent large and small specific capacities and theoretical yields are often found in close proximity. There appear to be more wells with larger theoretical yields in ground-water discharge areas where a greater degree of solution development of aquifer zones may occur.[4]

While it is recognized that wells which can yield 100 gpm have been developed in the Oxford formation, it is felt that to assign this large potential to the aquifer would be overly optimistic. On an average, it appears that wells

with yields of up to 50 gpm could be developed in the Oxford formation.

Rockcliffe and St. Martin Formations

Theoretical yields of wells seldom exceed 30 gpm and are commonly less than 10 gpm. The aquifers appear to be capable of yielding sufficient water for domestic purposes, but it is unlikely that large supplies can be developed in these aquifers.

Ottawa and Eastview Formations

As depicted in Figure 3, the Ottawa formation outcrops in a large portion of the study area. Aquifer development is heterogeneous and thick sections of the formation are non-productive. Brandon[1] reported that a 300-foot section in the Ottawa area contained no water.

Anomalous among the many wells which obtain supplies from the Ottawa formation, is well 5227 in the Meadowlands subdivision. This well, which appears to have penetrated 80 feet of the Ottawa formation, produced 150 gpm with 11 feet of drawdown during a 72-hour test. However, there is a possibility that the Ottawa and Rockcliffe formations have been eroded away in this area and that the well may obtain supplies from the Oxford formation.

The majority of wells that obtain supplies from

the Ottawa formation have theoretical yields that vary from 10 to 25 gpm. Test drilling experience beyond the study area, in both the Ottawa formation in the St. Lawrence Lowlands and in its counterpart in the Michigan basin, the Trenton and Black River formations, indicate that occurrences of wells that will yield 50 gpm are rare.

Billings, Carlsbad and Russell Formations

Comprising shales, these formations form poor aquifers. Specific capacities of wells generally vary from 0.1 to 0.5 gpm. Prospects for developing large supplies from these aquifers are extremely poor.

Overburden

The overburden comprises a complex of Pleistocene and post-Pleistocene sediments of glacial, glacio-fluvial, glacio-lacustrine, marine and fluvial origin. The sediments vary from zero to 440 feet in thickness, but are generally less than 100 feet thick.

For a detailed chronology and description of the surficial geology in the area, readers are referred to Gadd.[6] Briefly, continental glaciation sculptured the bedrock surface and deposited clayey till in some areas. As the glacier retreated, glacio-fluvial and glacial outwash sands and gravels were deposited in many of the bedrock depressions.

Morainic ridges, comprising kamic sands and gravels and some till, were formed near the ice front at times when the front was relatively stationary. The invasion of the Champlain Sea through the St. Lawrence River valley followed glaciation. Thick beds of clay were deposited and partially or completely buried the glacial sediments in many areas. Wave action along the shoreline of the sea reworked the glacial deposits into beaches of sand and gravel. As isostatic adjustment to withdrawal of the glacier raised the elevation of the land surface, the Champlain Sea withdrew and fresh-water, fluvial and lacustrine sediments, comprising clay and sands, were deposited over the marine sediments. Bog deposits accumulated in low, poorly drained areas.

Figure 4 shows the distribution of surface sands and gravels in the study area. Readers are referred to Gadd[6], Chapman and Putnam[3] and Hills et al[8] for details on the distribution of the tills and clays.

For the most part, overburden aquifers have not been extensively exploited. Only a few large-capacity wells have been constructed and include those at Carp, Graham Bay, Uplands Airport and Orleans. These wells have been developed in sand and gravel aquifers of various depositional environments.

The specific capacities of the large-capacity wells vary from about 11 to 50 gpm per foot of drawdown and the theoretical yields vary from 200 gpm to greater than 1,000 gpm. It is evident that well yields of up to 100 gpm or greater can be anticipated where there are laterally extensive sand and gravel beds that exceed 10 feet in thickness.

Data obtained from test-drilling programs have shown that rapid changes in sediment grain-size distribution and aquifer thickness may occur. Wells penetrating thick sand and gravel zones are often found near wells encountering fine sand or nonproductive sediments. Drillers frequently describe glacial till as sand and gravel or extend wells through the overburden aquifers into the bedrock. To outline the distribution of overburden aquifers it was necessary to interpret the drillers' lithologic descriptions with reference to the locations of known overburden wells and the geology.

Because of the foregoing and since all well records were not utilized in this study, some inconsistencies may occur in the interpretation of the distribution of overburden aquifers. More detailed studies should be undertaken in areas of interest to select the most favourable test-drilling sites.

Based on the above data, Figure 5 was constructed

and shows an interpretation of the extent of the major overburden aquifers, areas where aquifers may exceed 10 feet in thickness, and the chemical quality of the ground water. The aquifer thicknesses and their depths from the land surface can also be derived from the figure.

Figure 5 indicates that extensive aquifers are liberally distributed within the overburden. Generally, the sand and gravel deposits in the kame and glacial outwash moraines, in the glacio-fluvial outwash in bedrock depressions, and in the marine beaches have good potential for the development of large supplies.

Fine-grained surface sand deposits are abundant in the area but do not exhibit the potential to yield large supplies. They are generally less than 20 feet thick, as shown in Figure 2, have limited available drawdowns, and likely have small transmissibilities.

Springs occur in some areas but were not studied in detail. These sources of supply may not be reliable because water levels in source beds and, hence, discharge rates are low in summer periods when the water demands are large. However, in more detailed studies, springs could be investigated as potential sources of water supply.

Water Quality

Information on the chemical characteristics of ground water in the Ottawa-Carleton area was obtained from samples collected in the field, from OWRC and private test-drilling programs, and from all water-well records on file with the Division of Water Resources.

The locations of sampled, bedrock and overburden wells are shown in figures 3 and 5, respectively, and the results of chemical analyses are shown in tables 1 and 2, respectively. The locations of all wells in the study area that were reported to produce sulphurous, salty, or gassey water from the bedrock and overburden aquifers are shown in figures 3 and 5, respectively.

The Ontario Water Resources Commission has established drinking water objectives for chemicals in ground water.[14] For the chemical constituents analyzed for this survey, the recommended maximum limits are:

Constituent		Recommended Maximum Limit (mg/l)
Chloride	(Cl)	250
Iron	(Fe)	0.3
Nitrate	(as N)	10
Sulphate	(SO_4)	250

The ground water from the bedrock and the overburden aquifers is generally hard to very hard. The concentration of sulphate was acceptable for municipal purposes in all wells

sampled. One unacceptably large nitrate concentration was reported and likely indicates pollution. Iron concentrations frequently exceed the maximum recommended limits; however, in most cases, treatment could likely reduce the concentration to acceptable limits.

Hydrogen sulphide gas is reported in water from some wells. The gas imparts a foul odour to water but can be removed where concentrations are less than about 5 ppm.

The most troublesome chemical constituent, which is present in the ground water in some areas, is sodium chloride or common salt. Chloride in large concentrations imparts a salty taste to water. A high sodium content can be dangerous to heart patients on low salt diets. Sodium chloride cannot be economically removed from supplies with present technology.

Because of the foregoing, the term 'poor quality' in this report refers to sodium chloride and/or hydrogen sulphide waters. It is emphasized, however, that small amounts of hydrogen sulphide can be economically removed from water.

Based on the available data, areas of poor water quality can be generalized as follows:

1. Areas where aquifers underlie thick sections of marine clay.

2. Ground-water discharge areas near rivers and creeks where more occurrences of wells with poor water quality are reported.

3. The fault blocks between the Gloucester and Orleans faults. The poor quality may be caused by the presence of marine clays and shales. The cause of the apparent abrupt improvement in the quality of water east of the Orleans fault is not known but may be attributable to differences in the ground-water flow systems in the fault blocks or to larger bedrock transmissibilities east of the fault.

The quality of water from the various aquifers in the area can be summarized as follows:

Aquifer	Water Quality
Precambrian	Generally fresh
Nepean formation	Generally fresh, but rare occurrences of sulphurous water are known.
Oxford and March formations	Generally fresh, but may be sulphurous. Poor quality water is occasionally

Oxford and March formations (Con't.)	encountered in ground-water discharge areas and in the eastern half of the Township of Osgoode. In the northwest portion of the study area, salty water is obtained where the aquifer underlies thick marine clays.
Rockcliffe and St. Martin formations	Usually fresh, but may be sulphurous.
Ottawa and Eastview formations	Frequently sulphurous. Salty water may be encountered at depth and in ground-water discharge areas.
Billings, Carlsbad and Russell formations	Frequently salty, sulphurous, gassey.
Sand and Gravel	Usually fresh. Can be salty where overlain by thick marine clays, as in the Carlsbad Springs and Orleans areas.

Probable Well Yield

Figure 6 shows an interpretation of the water production that can be expected from individual wells based on geology and short-term and long-term pumping tests. The figure does not necessarily represent long-term yields from the aquifers although allowances for this factor have been attempted. Long-term or perennial yields are dependent on the rate of recharge to the aquifers from precipitation.

The boundaries of the areas presented are approximate. A transition from low- to high-yield conditions, or vice versa, can be anticipated near the boundaries of the areas.

Theoretical well yields are highly variable in any area and it may be possible to develop wells of larger than the indicated yield. The majority of wells in any area fall within the interpreted probable yield classification.

Figure 6 can be used in conjunction with figures 3 and 5 to determine the general locations and probable yields of aquifers, and the water quality. These data are presented to assist in the planning of test-drilling programs in areas of interest.

GROUND WATER RECHARGE AND AVAILABILITY

The source of natural ground-water recharge is precipitation. The portion of the total precipitation that infiltrates the soil to the water table and enters ground-water flow systems is difficult to determine because of a large number of variables which, among other factors, include geology and climatology.

Where streamflow data are available, an approximation of the ground-water recharge rate can be obtained by estimating the baseflow, or ground-water runoff, of streams in the area.

All major streams in the vicinity of the study area are subject to the influence of control dams. Baseflow separations from controlled streamflow data would tend to yield ground-water recharge estimates that are too large. Although values for ground-water recharge calculated from these data are likely unreliable, the method was attempted on data from the South Nation River to derive an indication of whether the recharge rates to aquifers are large or small.

Data from the Mississippi, Ottawa and Rideau rivers, which rise in the Precambrian Shield and drain large basins, are unrepresentative of the geology in the study area and were not used. Geologic and climatologic conditions in the South Nation River basin are similar to those in the Ottawa-Carleton area.

Streamflow data collected at Spencerville in the South Nation River basin were analyzed for the water year ending in 1967, which was a year of average precipitation, and for the water year ending in 1965, which was a year of low precipitation expected to occur on an average of one year out of ten. The ground-water recharge rates were calculated to be:

Water Year	Precipitation	Estimated Ground Water Recharge Rate
1965	29.4 inches	0.011 11,000 gpd per square mile
1967	34.4 inches	0.04 40,000 gpd per square mile

It is emphasized that the accuracy of the derived values is questionable. They may indicate, however, that the average ground-water recharge rate in the basin is not large. These values may be reasonable for the Ottawa-Carleton area, a large portion of which is blanketed with clays having small permeabilities and infiltration capacities.

The composition of surficial sediments in the Ottawa-Carleton area varies considerably; hence, recharge rates to aquifers also vary. Recharge studies in the State of Illinois[17] where geologic and climatologic conditions are somewhat similar to those in the study area, suggest that the rates of recharge to aquifers in the Ottawa-Carleton area could vary from 1,000 gpd per square mile in areas of thick clay and/or shale to 300,000 gpd per square mile in areas of sand and gravel. Areas in which the surficial sediments comprise thin clay, glacial till or bedrock probably have recharge rates which lie between these values.

All of the recharge is not recoverable from wells as all ground-water runoff cannot be diverted in the cones of depression of pumping wells. Even under heavy pumping conditions there is some lateral as well as vertical movement of water in the surficial deposits through which leakage or recharge to the aquifer occurs. Hydrogeologic studies in Illinois[17] have indicated that the amount of ground-water

recharge that can be recovered practically by wells may amount to about 60 per cent of the ground-water runoff. Similar recovery may be expected in the study area provided that wells are properly spaced and managed.

Data are too sparse to reliably determine the recharge rates to, and the perennial yields of aquifers in other than the foregoing rudimentary terms. A better estimate of ground-water availability could be made eventually by maintenance and periodic review of hydrologic data from large-capacity wells and observation wells as the ground-water resources of the area are developed.

WASTE DISPOSAL AND GROUND WATER POLLUTION

The City of Ottawa is experiencing rapid urban development, which has extended into the surrounding townships. Associated with such growth, there is an increasing demand for domestic and industrial waste disposal sites and, correspondingly, a need for the protection of the quality of ground water so that development in outlying areas may continue.

Although any specific disposal area must be judged on its own merits and on prevailing hydrogeologic conditions, in the course of this study it became evident that several geologic environments are present in which aquifers are highly susceptible to pollution. These can be generalized as follows:

1. Areas where thin overburden overlies the bedrock, as in the rock, plain and upland areas. These areas are likely major recharge areas for bedrock aquifers.

2. Areas where outcropping sand and/or gravel beds lie in contact with the bedrock. These sediments likely provide a source of ground-water storage and recharge for bedrock aquifers.

3. Areas traversed by the kame moraines. These deposits likely form the best overburden aquifers in the study area and often present the most appealing sites for waste disposal in abandoned sand and gravel pits. These areas are totally unsuitable for waste disposal. The moraines are hydraulically connected to the bedrock and pollution of both the overburden and bedrock aquifers can occur.

Conversely, areas in which waste disposal could cause a minimum pollution hazard to aquifers include:

1. Areas of thick clay which do not overlie major aquifers.
2. Areas underlain by shale.
3. Areas of thick glacial till.

GROUND WATER SURVEYS FOR COMMUNITIES

Water Requirements

In addition to communities that James F. MacLaren Limited has indicated will experience large rates of population growth to the year 1980, it was necessary to establish arbitrary criteria to ascertain which of the many smaller communities may eventually require a municipal water-supply system. It was assumed that the rate of population growth in rural areas would be 3 per cent per annum and that the lower limit of population that could finance a system would be 300 by the year 2000. On this basis, communities which have a present population of about 100 may eventually require a municipal system.

Assuming an average per capita water consumption of 50 gallons per day and suitable factors for maximum daily use, the water requirements of 24 communities were estimated. These data are shown in Table 3.

The water requirements are based on the anticipated domestic demand and do not include allowances for industrial or unanticipated subdivision developments.

Supplies should be developed to provide the maximum day demand. Storage would be required to meet peak hourly and/or emergency demands.

Potential for Development

A summary is given below for centres which may have populations exceeding 300 by the year 2000 of the relative potential of obtaining an adequate quantity of ground water, the potential for obtaining good quality water with respect to hydrogen sulphide and sodium chloride, the potential sources of supply and remarks pertaining to these sources.

This summary does not preclude the need for more detailed ground-water surveys in some areas to select the most favourable test-drilling sites. More comprehensive sampling programs would be required to outline areas of poor water quality, including those areas where iron concentrations are large.

All test wells may not be successful, even in areas assessed as having good development potential.

Township of Fitzroy - FITZROY HARBOUR

Water Requirements:	55 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Bedrock aquifers in the Oxford formation.

Remarks:

Drilling can be initiated in the Oxford or Rockcliffe formations at convenient locations. Wells should be

extended until sufficient supplies are obtained or until the Oxford-Precambrian contact is reached. The aquifer may be better developed in the vicinity of Fitzroy Station.

Township of Fitzroy - GALETTA

Water Requirements:	45 gpm by the year 2000.
Potential for Quantity:	Fair.
Potential for Good Quality:	Indefinite.
Potential Source of Supply:	Bedrock aquifers in the Oxford formation in locations at least ½ mile southwest of Galetta. Overburden aquifer about 2 miles southeast of Galetta.

Remarks:

Theoretical yields of domestic bedrock wells average about 20 gpm; therefore, more than one production well may be required. Wells should be extended until sufficient supplies are obtained or until the Oxford-Precambrian contact is reached. Surface sand and gravel deposits northwest and southeast of Galetta can be tested but may be unsaturated. Costs of developing supplies from the overburden aquifer southeast of the community may be prohibitive because of high tie-in costs.

Township of Fitzroy - KINBURN

Water Requirements:	50 gpm by the year 2000.
Potential for Quantity:	Indefinite.
Potential for Good Quality:	Poor to fair, may be salty.
Potential Source of Supply:	Sand and gravel aquifer between the Mississippi River and Kinburn, along the north flank of the bedrock valley. Bedrock aquifers in the Oxford formation northwest of Kinburn.

Remarks:

Data in the area are sparse. Water quality may be acceptable where the overburden aquifer lies at relatively shallow depth. East of Kinburn, the overburden aquifer may be fine-grained.

Township of Huntley - CARP

Water Requirements:	100 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Overburden aquifer underlying Carp.

Remarks:

Test drilling can be undertaken in convenient locations in or near Carp. The Department of National Defence has constructed several large-capacity wells near the northwest limits of Carp. To minimize effects of interference, wells should be constructed away from this area.

Township of March - KANATA
Township of Goulbourn - GLEN CAIRN

Water Requirements: 2,700 gpm by the year 1980.

Potential for Quantity: Nil.

Remarks:

Both subdivisions are presently supplied by bedrock wells constructed in the Nepean sandstone aquifer. The average rate of production from municipal wells is about 220 gpm. It appears that the aquifer is being dewatered at the present rate of production, although the drawdowns in the wells may eventually stabilize as the pumping cones of depression get larger. Supplies greater than the average rate of production could be available for short periods of time by taking more water from storage and increasing the rate of dewatering. Severe interference with domestic well supplies can be expected. The prospects of developing additional ground-water supplies within a reasonable distance of the communities may be poor because of the geology of the area. If stop-gap measures are required, test drilling could be undertaken in a southerly direction toward the Hazeldean fault or in an easterly direction from Glen Cairn. If the area expands at the anticipated growth rate, a surface-water supply will likely be required.

Township of Goulbourn - ASHTON

Water Requirements:	30 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good to fair.
Potential Source of Supply:	Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken in convenient locations. Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean sandstone is penetrated.

Township of Goulbourn - MUNSTER

Water Requirements:	130 gpm by the year 1975.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Bedrock aquifers in the Nepean formation.

Remarks:

Recent test drilling successfully located a supply of 150 gpm from a 380-foot deep well constructed in the Nepean sandstone. A gasoline pollution problem, which could affect ground-water quality, exists in the community.

Township of Goulbourn - RICHMOND

Water Requirements:	310 gpm by the year 1980.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken in convenient locations. Wells should be extended 200 feet or deeper into the Nepean formation. More than one well may be required. Systematic spacing of wells should be practised.

Township of Goulbourn - STITTSVILLE

Water Requirements:	350 gpm by the year 1980.
Potential for Quantity:	Poor to fair.
Potential for Good Quality:	Good to fair.
Potential Source of Supply:	Overburden aquifers in kame moraine and marine beaches northwest of Highway 15 along the Carp road. Bedrock aquifers underlying Stittsville.

Remarks:

The recharge area of the unconfined sand and gravel aquifers northwest of Stittsville may not be large enough to provide the potential water requirements on a perennial basis. As the aquifer is under water-table conditions,

limited available drawdown could restrict the yields of wells.

Regionally, the Ottawa formation is a poor aquifer but many wells in Stittsville have larger-than-average specific capacities and theoretical yields. Sulphurous water may be encountered. Test drilling could be undertaken to evaluate the aquifer potential of the Ottawa formation. There is some possibility that aquifers in the Oxford and Nepean formations could be exploited with wells deeper than 500 feet. Water quality from the deep bedrock could be poor. A multiple-well system would likely be required. Systematic spacing of wells should be practised.

Township of Gloucester - CARLSBAD SPRINGS

Water Requirements:	60 gpm by the year 2000.
Potential for Quantity:	Fair to good.
Potential for Good Quality:	Poor, likely salty.
Potential Source of Supply:	Overburden aquifer which apparently extends westward from the community.

Remarks:

The aquifer may have large variations in thickness. One well southeast of the community obtained fresh water from 46 feet of sand and gravel at a depth of 44 feet. The chemical quality of water from any large-capacity well could deteriorate with time as the water in the aquifer is generally reported to be salty.

Township of Gloucester - ORLEANS

Water Requirements:	520 gpm by the year 1980.
Potential for Quantity:	Indefinite.
Potential for Good Quality:	Poor to fair, may be salty.
Potential Source of Supply:	Additional development in the existing municipal well field. Overburden aquifers about 2½ miles east and southeast of Orleans. Bedrock aquifers in the Oxford and Nepean formations north of Highway 17 and the Orleans fault.

Remarks:

The rate of recharge to overburden aquifers is likely small because of the thick overlying clay beds. Data indicate that dewatering of the aquifer may be occurring at the present production rate of 85 gpm. Additional short-term supplies may be made available by expanding the existing well field and increasing the rate of dewatering of the aquifer. Considerable test drilling would likely be required to locate suitable well sites. Severe interference with domestic supplies could be expected.

Additional supplies may be available from an overburden aquifer two and one-half miles east of Orleans. The yield from this aquifer would likely be similar to the

above-mentioned aquifer. Interference with domestic supplies could be expected.

Large-capacity wells have been developed for the Parks and Gardens subdivision in the overburden aquifer southeast of Orleans. Development in this area could cause interference with these wells.

Near the Ottawa River and north of the Orleans fault, two wells appear to have been drilled about ten feet into the Nepean sandstone. The wells penetrate only a few feet of the Nepean formation and have small theoretical yields. The water was reported to be fresh. The potential of the bedrock aquifers in the area could be determined.

In summary, there are several aquifers from which additional supplies may be obtained for Orleans on a short-or-long-term basis. The yields from the aquifers cannot be evaluated at this time.

Township of Gloucester - SOUTH GLOUCESTER

Water Requirements:	60 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Overburden aquifers in Bowesville Ridge beneath and west of the community. Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation has been penetrated. It may be more economical to develop wells in the rock, if the quality of the water is suitable.

Township of Cumberland - CUMBERLAND

Water Requirements:	135 gpm by the year 2000.
Potential for Quantity:	Fair.
Potential for Good Quality:	Fair.
Potential Source of Supply:	Overburden aquifers east and west of the community. Bedrock aquifers in the Oxford and Nepean formations along the Ottawa River.

Remarks:

Thick clay beds overlying the aquifers may limit recharge and perennial yield. The potential of the Oxford and Nepean formation aquifers can be tested.

Township of Cumberland - NAVAN

Water Requirements:	60 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Fair.
Potential Source of Supply:	Overburden aquifer which underlies Navan.

Remarks:

Test drilling can be conducted in convenient locations in or near the community. The bedrock yields sulphurous water in some areas, which could influence the quality of water from any large-capacity overburden well.

Township of Cumberland - SARSFIELD

Water Requirements:	65 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Overburden aquifer which underlies the community.

Remarks:

Test drilling can be carried out in convenient locations in or near the community.

Township of Cumberland - VARS

Water Requirements:	70 gpm by the year 2000.
Potential for Quantity:	Indefinite, likely poor.
Potential for Good Quality:	Good.
Potential Source of Supply:	Drillers' logs indicate there may be a shallow overburden aquifer about one mile east of Vars.

Remarks:

There are insufficient data in the vicinity of Vars to adequately evaluate the aquifer potential. The shale bedrock does not have the potential to yield large supplies.

Township of North Gower - KARS

Water Requirements:	40 gpm by the year 2000.
Potential for Quantity:	Good.
Potential for Good Quality:	Good.
Potential Source of Supply:	Overburden aquifer underlying Kars. Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken at convenient locations in or near Kars. If supplies are not found in the overburden, wells should be extended into the rock until sufficient supplies have been obtained or until about 200 feet of the Nepean sandstone has been penetrated. It may be more economical to develop wells in the bedrock, if the water quality is acceptable.

Township of North Gower - MANOTICK

Water Requirements:	1,900 gpm by the year 1980.
Potential for Quantity:	Indefinite, likely poor to fair.

Potential for Good Quality: Good to fair, chance of hydrogen sulphide gas.

Potential Source of Supply: Overburden aquifer in kame moraine one mile west of Manotick. Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

A large rate of population growth has been predicted by the consulting engineer. The overburden and bedrock aquifers may be able to supply large quantities of water but recharge rates to the aquifers are unknown. If the rate of recharge is as large as 150,000 gpd per square mile and one-half of the recharge could be diverted to wells, a recharge area of 36 square miles would be required to balance the ultimate withdrawal. Otherwise, mining of the aquifer would occur. Well interference could be experienced over a wide area. Systematic spacing of wells would be required.

Test drilling could be undertaken to determine the characteristics of aquifers in the area. Practically speaking, because of anticipated serious well interference problems, ground water may only form a stop-gap supply until a source of surface water could be made available.

Township of North Gower - NORTH GOWER

Water Requirements: 45 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Fair, may be sulphurous.

Potential Source of Supply: Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken at convenient locations. Wells can be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation is penetrated. Ground water on the south side of North Gower is reported to be sulphurous.

Township of Osgoode - GREELY

Water Requirements: 75 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Good to fair.

Potential Source of Supply: Overburden aquifer underlying Greely. Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken in convenient locations. Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation has been penetrated.

Township of Osgoode - KENMORE

Water Requirements: 40 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Good to fair.

Potential Source of Supply: Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken at convenient locations. Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation has been penetrated.

Township of Osgoode - METCALFE

Water Requirements: 90 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Fair.

Potential Source of Supply: Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken at convenient locations. Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation has been penetrated. Water supplies may be sulphurous.

Township of Osgoode - OSGOODE

Water Requirements: 160 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Good.

Potential Source of Supply: Overburden aquifers north of the community and in the Bowesville Ridge about two miles east of Osgoode. Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

The overburden aquifer in the vicinity of Osgoode appears discontinuous and the recharge area may be limited. Aquifers in the kame moraine of the Bowesville Ridge and/or the Nepean formation likely offer the best prospects for developing the required supplies.

Township of Osgoode - VERNON

Water Requirements: 55 gpm by the year 2000.

Potential for Quantity: Good.

Potential for Good Quality: Good.

Potential Source of Supply: Bedrock aquifers in the Oxford and Nepean formations.

Remarks:

Test drilling can be undertaken at convenient locations. Wells should be extended until sufficient supplies are obtained or until about 200 feet of the Nepean formation has been penetrated.

SUMMARY AND CONCLUSIONS

The best bedrock aquifers in the study area occur in the Oxford and Nepean formations and, of these, the Nepean sandstone is believed to be capable of yielding the largest water supplies. Generally speaking, these formations contain the only aquifers which have the potential to yield large supplies. Because of faulting, the Nepean sandstone lies within reach of deep wells in about one-half of the study area. Wells which penetrate 100 feet or more of the Nepean sandstone commonly yield more than 100 gpm.

Overburden aquifers are liberally distributed within the overburden sediments in many parts of the area. The aquifer sediments comprise sand and gravel beds in kame moraines, glacio-fluvial and/or glacial outwash, and marine beaches. In areas where the aquifers are laterally extensive and exceed ten feet in thickness, wells may be developed to yield greater than 100 gpm.

Most of the chemical constituents in the ground water occur in concentrations which are acceptably low, except

for occurrences of iron, hydrogen sulphide and sodium chloride, in some areas. Of these substances, iron and hydrogen sulphide within certain concentration limits can be removed by treatment. Sodium chloride or common salt cannot be removed from water supplies economically.

Wells with poor quality water are more numerous in areas where the aquifers underlie thick sections of marine clay, in ground-water discharge areas, and in the area between the Gloucester and Orleans faults. Sporadic occurrences of poor quality water are reported from all aquifers.

Figure 6 shows an interpretation of the water production that can be expected from individual wells based on geology and short-term and long-term pumping tests. Long-term yields are not indicated as this would depend on the rate of the recharge to aquifers from precipitation.

By combining data from figures 3, 5 and 6, the general locations and probable yields of aquifers and the ground-water quality can be approximated. In areas where overburden aquifers or bedrock aquifers with poor yield characteristics are to be tested, more detailed ground-water surveys should be undertaken to determine the best test-drilling sites. Where the Oxford and Nepean aquifers are to be tested, additional surveys need not be undertaken as the well yield will depend on the number and size of the

fractures and joints intercepted at any location. All bedrock test wells may not be successful in yielding large supplies but the success ratio should be high. In any test-drilling program, areas of better quality ground water should be ascertained by additional sampling and analysis.

The rate of recharge to the aquifers in the study area is not reliably known, but based on limited data, it could average less than 50,000 gpd per square mile. With all other factors being equal, the rate of recharge to aquifers varies from place to place, depending on the composition of the geologic formations. In areas of shale or thick clay, the rate of recharge could be as small as 1,000 gpd per square mile and in areas of sand and gravel, it could be as large as 300,000 gpd per square mile. Additional studies of recharge to the aquifers in the area should be undertaken as more data become available to determine the safe yields of aquifers and the best methods of managing the ground-water resources of the Ottawa-Carleton area.

Aquifers in several geologic environments are highly susceptible to pollution from any contaminant spilled or placed on the ground surface. These include areas of moraines, areas of thin overburden, and areas where surface sand and gravel lie in contact with bedrock aquifers. Generally, these areas should not be used for waste disposal.

Brief studies were made of the aquifer potential in the vicinities of 24 communities that may eventually require a municipal water-supply system. The following summarizes the results:

Community	Requirements (gpm)	Potential Quantity	Potential Quality	Aquifer*
Fitzroy Harbour	55	Good	Good	BR
Galetta	45	Fair	Indefinite	OB & BR
Kinburn	50	Indefinite	Poor-Fair	OB & BR
Carp	100	Good	Good	OB
Kanata-Glen Cairn	2700	Nil	Good	BR
Ashton	30	Good	Good-Fair	BR
Munster	130	Good	Good	BR
Richmond	310	Good	Good	BR
Stittsville	350	Poor-Fair	Good-Fair	OB & BR
Carlsbad Springs	60	Fair-Good	Poor	OB
Orleans	520	Indefinite	Poor-Fair	OB & BR
South Gloucester	60	Good	Good	OB & BR
Cumberland	135	Fair	Fair	OB & BR
Navan	60	Good	Fair	OB
Sarsfield	65	Good	Good	OB
Vars	70	Indefinite	Good	OB
Kars	40	Good	Good	OB & BR
Manotick	1900	Indefinite	Good-Fair	OB & BR
North Gower	45	Good	Fair	BR
Greely	75	Good	Good-Fair	OB & BR
Kenmore	40	Good	Good-Fair	BR
Metcalfe	90	Good	Fair	BR
Osgoode	160	Good	Good	OB & BR
Vernon	55	Good	Good	BR

* BR - Bedrock OB - Overburden

RECOMMENDATIONS

Test-drilling programs conducted in the Ottawa-Carleton area should include accurate lithologic logging of the formations intercepted, retention of lithologic samples for examination, and extended pumping tests to determine the water-yielding characteristics of potential aquifers to refine the present hydrogeologic interpretation and to detect any changes in water quality.

Records of static levels and pumping levels, the times when the water-level measurements are taken, the duration of the pumping period when the pumping level is measured, and rates of production should be maintained on a continual basis for municipal wells. Studies of these data will aid in the assessment of well and aquifer performance.

Consideration should be given to the installation of observation wells at strategic locations in the vicinity of well fields, and of gauging stations on uncontrolled water courses. Comparisons of reliable information on water levels in the aquifers, baseflow conditions in streams, and ground-water withdrawals may permit calculation of the ultimate yield from the aquifers.

If possible, waste disposal should not be carried out in the areas of high aquifer pollution hazard discussed in this report.

All of which is respectfully submitted,

Prepared by: A. A. Sobanski, P. Eng.,
Hydrogeologist,
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Supervised by: T. J. Yakutchik, Supervisor,
Surveys and Projects Branch.

for K. E. Symons,
Director,
Division of Water Resources.

AAS/lb
26/2/70

TABLE 1: BEDROCK WATER QUALITY

ONTARIO WATER RESOURCES COMMISSION

TABLE OF WATER ANALYSES

AREA OF SURVEY OTTAWA - CARLETON

BEDROCK WATER QUALITY

DATE December, 1969

Source and Number	Location and Owner	Date Sampled	Temperature in °F	pH at lab	Mineral Constituents in parts per million (ppm) ~~equivalents per million (epm)~~: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Total Iron (Fe)	Fluoride (F)	Nitrate (N..)	Alkalinity as ppm $CaCO_3$	Hardness as ppm $CaCO_3$: Total	Hardness: Calcium	Total Dissolved Solids in ppm	Specific Conductance (micromhos at 25°C)	Remarks: Aquifer
129	C. Bidgood GALETTA	OCT. 1969		8.0			156	2.1			64	32	0.15		0.11	250	8				Precambrian
204	H. Dolan FITZROY HARBOUR	OCT. 1969		8.0			144	14.5			80	65	0.15		0.90	398	231				Oxford
224	Baird's Store FITZROY HARBOUR	OCT. 1969		7.6			65	8.1			54	27	5.40		0.07	310	246				Oxford
356	E. Morris SARSFIELD	OCT. 1969		7.7			35	3.1			41	23	0.75		0.03	296	286				Ottawa
491	E. McNab VARS	OCT. 1969		7.3			32	4.2			64	57	0.35		7.4	284	370				Carlsbad
546	J. Cotton & Sons NAVAN	OCT. 1969		7.8			34	3.5			31	4	0.35		0.01	238	190				Ottawa
719	D.N.D. TWP OF GLOUCESTER			7.3	267	205					124	39				272	272				Ottawa
2267	M. Millar TWP. OF GLOUCESTER	OCT 1969		7.5			13	5.8			91	32	0.15		0.20	294	387				Nepean
2508	V. Banks ASHTON	OCT 1969		7.6			18	8.0			34	32	0.20		0.23	249	270				Ottawa?
2544	W. McKay ASHTON	OCT. 1969		7.5			15	3.6			30	30	0.15		0.66	282	313				Ottawa?
2605	R. Berry STITTSVILLE	MAY 1963		7.8							19	23	0.08	0.0	1.3	214	244				Ottawa
3094	Huntley P.S. CARP	OCT 1969		7.9			55	3.1			31	67	0.45		0.01	173	180				Ottawa like[illegible] connected to overlying s[illegible]

ONTARIO WATER RESOURCES COMMISSION

TABLE OF WATER ANALYSES

AREA OF SURVEY OTTAWA - CARLETON

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5082	White Hill Subd. Twp of Nepean	Apr. 1969		7.8			15	3.0			109	24	0.79			178	296				Oxford-Nepean
5227	Meadowlands Subdiv. Twp of Nepean	Apr. 1969		8.0								21	0.20			148	300				Oxford?
6019	Manordale - Green Glen Twp of Nepean	Apr. 1969		8.0								52	0.20			166	218				Nepean
6020	Woodvale Subd. Twp of Nepean	Apr. 1969		8.0								94	0.15			157	261				Nepean
6054	Barrhaven Subdiv. Twp of Nepean	Apr 1969		7.9								19	0.05			263	285				Nepean
6224	Lynnwood Subdiv. Twp of Nepean	Apr. 1969		8.0								17	0.25			183	182				Nepean
6493	W. Goodard Manotick	Oct. 1969		7.6			63	5.3			163	145	1.35		<0.01	320	552				Oxford or Nepean
6508	P. Boucher Manotick	Oct. 1969		7.4			36	7.9			152	67	0.20		0.09	479	528				Oxford
6739	J. Driscoll Kars	Oct. 1969		8.0			21	5.5			24	9	0.15		<0.01	199	175				Oxford
6932	Mr. Richards N. Gower	Oct 1969		7.9			10	1.9			74	15	0.15		0.69	244	309				Oxford
6968	G. Cowel N. Gower	Oct. 1969		7.8			8	2.2			95	23	0.55		<0.01	255	355				Oxford
7118	Post Office Osgoode	Oct. 1969		8.3			14	2.4			11	9	0.20		0.19	102	85				Oxford

ONTARIO WATER RESOURCES COMMISSION

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7153	W. Eggens Twp. of Osgoode	Oct. 1969		7.9			7	6.8			33	4	0.75		0.08	207	216				Oxford
7414	C. Johnston Twp. of Osgoode	Oct. 1969		7.8			165	8.7			73	198	0.25		0.03	252	249				Oxford
7459	B. Acres Twp. of Osgoode	Oct. 1969		7.9			44	9.5			41	20	0.25		<0.01	228	187				Oxford
7614	G. Bray Metcalfe	Oct. 1969		7.6			24	4.2			128	61	1.70		0.05	366	512				Oxford
7675	M. Ross Kenmore	Oct. 1969		7.5			11	2.7			80	22	0.20		0.71	328	404				Oxford
9177	J. McRae Richmond	Oct. 1969		8.0			44	6.0			33	44	0.45		0.09	225	207				Oxford?
9289	E. Shaver Richmond	Oct. 1969		7.9			61	7.6			40	49	0.20		0.07	232	201				Rockcliffe?
S	E. Hulshof Stittsville	Oct. 1969		7.6			22	3.1			23	56	0.20		8.2	211	280				Ottawa
9375	J. Pottier Stittsville	Oct. 1969		7.4			27	4.4			51	111	0.10		1.97	269	411				Ottawa
9389	K. Lakey Stittsville	May 1963		8.2							70	10	2.40	0.9	tr	404	452				Ottawa
9573	J. Ferguson Kinburn	Oct. 1969		8.0			512	10.9			99	430	0.35		0.04	533	74				Ottawa?
9886	D. Tubman Munster	Oct. 1969		7.8			49	6.7			34	37	0.60		0.02	296	263				Oxford

ONTARIO WATER RESOURCES COMMISSION

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AREA OF SURVEY OTTAWA - CARLETON

DATE December, 1969

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2447	Mr. Lightbody MUNSTER	DEC. 1969		7.8								27	2.50			237	248				Oxford
T W	Subdivision well MUNSTER	DEC. 1969		7.4					0.0	310		246	0.0	0.0		310	240	120			Oxford - Nepean
9926	Kanata Subd. TWP OF MARCH	JULY 1969		8.0								20	1.20			195	210				Nepean
10009	Kanata Subd. TWP OF MARCH	JULY 1969		7.6								28	0.20			219	244				Nepean
10116	Twp of Gloucester TWP OF GLOUCESTER	APR 1969		7.5								100	0.0			125	170	105			Nepean
10196	Glen Cairn Subd. TWP OF NEPEAN	JUNE 1969		7.3						235		50	0.0			235	255	165			Nepean
24 - 1237	PUC # 4 KEMPTVILLE	DEC. 1969		7.9			58	6.7			61	66	0.60		0.10	217	256			Tr H_2S	Oxford-Nepean

TABLE 2: OVERBURDEN WATER QUALITY

ONTARIO WATER RESOURCES COMMISSION

TABLE OF WATER ANALYSES

AREA OF SURVEY OTTAWA – CARLETON

OVERBURDEN WATER QUALITY

DATE December, 1969

Source and Number	Location and Owner	Date Sampled	Temperature in °F	pH at lab	Mineral Constituents in parts per million (ppm) ~~equivalents per million (epm)~~ Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Total Iron (Fe)	Fluoride (F)	Nitrate (N[illegible])	Alkalinity as ppm $CaCO_3$	Hardness as ppm $CaCO_3$ Total	Hardness as ppm $CaCO_3$ Calcium	Total Dissolved Solids in ppm	Specific Conductance (micromhos at 25°C)	Remarks
160	R. Gourlay KINBURN	OCT. 1969		8.1			311	13.3			58	355	1.15		0.72	252	116				
717	Fire Hall CUMBERLAND	NOV. 1969		7.1				3.2			77	34	0.20		0.02	250	264				
385	R. Villeneuve SARSFIELD	OCT 1969		7.8			20	2.6			30	10	1.90		<0.01	273	261				
454	A. Devine VARS	OCT 1969		7.5			24	8.8			133	24	0.45		3.4	310	416				
514	C. Armstrong NAVAN	OCT. 1969		8.0			15	4.3			22	5	0.30		0.03	211	194				
679	Orleans Mun. Well TWP. OF GLOUCESTER	SEPT 1967		8.3	51		280				35	327	0.35			393	228				
TW 11-62	Parks & Gardens Subdiv. TWP. OF CUMBERLAND	MAY 1968		8.2	30						42	131	0.78	0.7		348	110				
1563	J. Desjardiner CARLSBAD SPRGS.	DEC. 1969		8.1			108	6.4			55	84	0.25		18.0	345	324				
1570	G. Erbs CARLSBAD SPRGS.	DEC 1969		7.6			356	11.7			23	587	2.8		0.10	286	320				
2301	P. Morozuk SOUTH GLOUCESTER	OCT 1969		7.6			8	2.7			46	22	0.30		0.10	291	338				
3139	A. Cox CARP	OCT 1969		8.4			116	12.9			5	8	0.30		<0.01	320	55				
5989	C.F.B. UPLANDS	APR. 1968		7.9			17	1.9			51	27	0.15			200	268				

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AREA OF SURVEY OTTAWA - CARLETON

DATE December, 1969

Source and Number	Location and Owner	Date Sampled	Temperature in °F	pH at lab	Mineral Constituents in parts per million (ppm) ~~equivalents per million (epm)~~ Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Total Iron (Fe)	Fluoride (F)	Nitrate (NO_3)	Alkalinity as ppm $CaCO_3$	Hardness as ppm $CaCO_3$ Total	Hardness as ppm $CaCO_3$ Calcium	Total Dissolved Solids in ppm	Specific Conductance (micromhos at 25°C)	Remarks
6029	H. Stintson TWP OF N. GOWER	OCT. 1969		8.5			117	0.2			47	6	0.25		<0.01	195	2				
6611	A. Rice TWP. OF N. GOWER	OCT. 1969		8.0			8	4.6			40	6	0.20		0.02	191	208				
7300	I. Wallace GREELY	OCT. 1969		7.8			14	2.0			43	35	0.15		3.6	221	282				
9936	V. Kvash KARS	OCT. 1969		7.9			11	3.1			40	19	0.30		1.78	217	255				

TABLE 3: ANTICIPATED WATER REQUIREMENTS

Table 3 Anticipated Water Requirements

COMMUNITY	POPULATION		WATER REQUIREMENTS		
	Present	Projected to 1980* or 2000	Avg. Day gpm	Max. Day Factor	Max. Day gpm
TWP. OF FITZROY					
Fitzroy Harbour	206	560	20	2.75	55
Galetta	162	440	15	3.00	45
Kinburn	176	490	17	3.00	50
TWP. OF HUNTLEY					
Carp	410	1120	39	2.50	100
TWPS. OF MARCH AND GOULBOURN					
Kanata and Glen Cairn	870	43000*	1500	1.80	2700
TWP. OF GOULBOURN					
Ashton	109	300	10	3.00	30
Munster	-	1500*	52	2.50	130
Richmond	1418	4500*	155	2.00	310
Stittsville	1785	5000*	175	2.00	350
TWP. OF GLOUCESTER					
Carlsbad Springs	234	640	22	2.75	60
Orleans	1510	7500*	260	2.00	520
South Gloucester	221	600	21	2.75	60
TWP. OF CUMBERLAND					
Cumberland	616	1540	53	2.50	135
Navan	246	620	22	2.75	60
Sarsfield	275	690	24	2.75	65
Vars	290	720	25	2.75	70
TWP. OF NORTH GOWER					
Kars	133	360	13	3.00	40
Manotick	1014	30000*	1040	1.80	1900
North Gower	162	410	14	3.00	45
TWP. OF OSGOODE					
Greely	284	780	27	2.75	75
Kenmore	151	380	13	3.00	40
Metcalfe	416	1040	36	2.50	90
Osgoode	742	1860	65	2.75	160
Vernon	216	590	21	2.75	55

* The consulting engineering firm, James F. McLaren, Ltd., has predicted rapid rates of growth for these communities to the year 1980.

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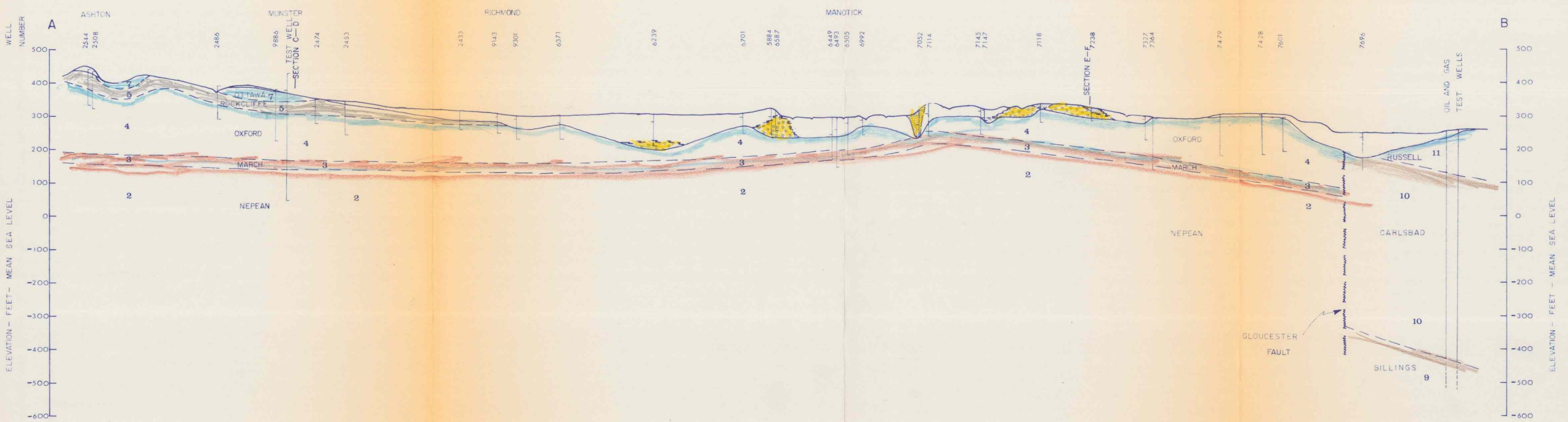
FIGURES



LEGEND

SAND

SAND and GRAVEL

SCALES: HORIZONTAL — 1 INCH = 1.58 MILES; VERTICAL — 1 INCH = 200 FEET

ONTARIO WATER RESOURCES COMMISSION

REGIONAL MUNICIPALITY of OTTAWA–CARLETON

GROUND WATER SURVEY
GEOLOGIC CROSS-SECTION
A – B

DATE: DEC 69	SCALE:	DRAWING NO. 2102-5
BY: AAS & SFS		

FIGURE — 1


C
D
MUNSTER
STITTSVILLE
KANATA
SECTION A-B
TEST WELL
WELL NUMBER
ROCKCLIFFE
OXFORD
MARCH
NEPEAN
OTTAWA
PRECAMBRIAN
HAZELDEAN FAULT
E
F
KEMPTVILLE
OSGOODE STA.
GREELY
RAMSAYVILLE
ORLEANS
OIL & GAS TEST WELL
CARLSBAD
BILLINGS
GLOUCESTER FAULT
ST. MARTIN
ORLEANS FAULT
ELEVATION — FEET — MEAN SEA LEVEL
LEGEND
SAND
SAND and GRAVEL
SCALES HORIZONTAL — 1 INCH = 1.58 MILES
VERTICAL — 1 INCH = 200 FEET
ONTARIO WATER RESOURCES COMMISSION
REGIONAL MUNICIPALITY of OTTAWA - CARLETON
GROUND WATER SURVEY
GEOLOGIC CROSS-SECTIONS
C—D & E—F
DATE: DEC. 69
BY: A.A.S. & S.F.S.
SCALE:
DRAWING NO.
2102-6
FIGURE 2

LEGEND

- 3 Sands (undifferentiated) - high terrace alluvium, comorising medium-to fine-grained sand deposited in former river channels
  - Champlain Sea sand comprising fine-grained sand deposited in shallow water
- 2 Marine beach gravels - gravels with some sand derived mainly from older glacial sediments
- 1A Esker sediments - stratified sand and gravel
- 1 Morainic materials - chiefly kamic and outwash gravels with some glacial till

REGIONAL MUNICIPALITY BOUNDARY

TOWNSHIP BOUNDARY

GREEN-BELT BOUNDARY

GEOLOGY AFTER

GADD N. R., Surficial Geology, Ottawa Map Sheet, Map 16-1962, G.S.C.,1963

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BASE MAP DERIVED FROM 1:50,000 NATIONAL TOPOGRAPHIC SERIES

ONTARIO WATER RESOURCES COMMISSION

REGIONAL MUNICIPALITY of OTTAWA - CARLETON GROUND WATER SURVEY

DISTRIBUTION OF SURFACE SANDS AND GRAVELS

Scale 1:100,000 or 1.58 Miles to 1 Inch

Miles

Kilometres

DATE	DRAWN BY	DRAWING NO.
DEC. 17, 1969	A.A. Sobanski — S.F. Sisson	2102-3

FIGURE — 4

LEGEND

- ● Well which obtains water supplies from the overburden
- ○ Well which appears to penetrate at least 10 feet of confined, saturated sand and gravel.
- ⊖ Well which appears to penetrate at least 10 feet of unconfined, saturated sand and gravel.

25(1)/100(2)

(1) Interpreted thickness of saturated sand and gravel aquifer (excludes sand beds which may overlie or underlie the aquifer.)

(2) Depth in feet to the top of sand and gravel aquifer

General distribution of major overburden aquifers

Interpreted extent of aquifer zones which may exceed 10 feet in thickness

—500— Elevation contours on the top of the bedrock surface—feet above mean sea level

A——B Line of geologic cross-section

REGIONAL MUNICIPALITY BOUNDARY

TOWNSHIP BOUNDARY

GREEN-BELT BOUNDARY

WATER QUALITY from OVERBURDEN WELLS*

3139 ● Sampled well

Slightly sulphurous

Moderately to highly sulphurous

Slightly salty

Moderately to highly salty

* REPORTED IN DRILLERS' RECORDS

Sources of Information

Well information from water well records on file with the Ontario Water Resources Commission

Bostock J.M., Drift— Thickness Contours, City of Ottawa, Map 39-1959, G.S.C.

BASE MAP DERIVED FROM 1:50,000 NATIONAL TOPOGRAPHIC SERIES

ONTARIO WATER RESOURCES COMMISSION

REGIONAL MUNICIPALITY of OTTAWA – CARLETON GROUND WATER SURVEY

DISTRIBUTION OF MAJOR OVERBURDEN AQUIFERS AND WATER QUALITY

BEDROCK CONTOURS

Scale 1:100,000 or 1.58 Miles to 1 Inch

DATE	DRAWN BY	DRAWING NO.
DEC 17, 1969	A.A. Sobanski S.F. Sisson	2102—1

FIGURE— 5


N
D
F
Orleans
Fault

LEGEND

5 Areas where wells are likely to produce up to 10 gpm (gallons per minute). Yields are limited by low permeabilities of aquifers. Areas include the Precambrian granitic and metasedimentary rocks in the central-northwest section of the study area and the thick shales of the Carlsbad formation and in part, the shales of the Billings formation in the eastern section of the study area. Ground waters from the Carlsbad and Billings formation aquifers are commonly salty or sulphurous.

4 Areas where wells are likely to produce up to 25 gpm. These areas are underlain by relatively thick sections of the Ottawa formation where drilling to deep, potentially more productive aquifers would generally be impractical. The water from these areas is often salty or sulphurous.

3 Areas where wells are likely to produce up to 50 gpm. Areas include (1) the Rockcliffe and the Oxford formations in the northwest of the study area -- the probable well yield is based on the aquifer potential exhibited by the Oxford formation. (2) the thick sedimentary rock section from the Ottawa formation to the Nepean formation in the vicinity of Ottawa. Very deep drilling is required in this area.

2 Areas where wells are likely to produce up to 100 gpm or greater from overburden aquifers. These areas are based on geology and on wells which appear to penetrate at least 10 feet of saturated sand and gravel. The aquifer deposits comprise sands and gravels of kamic, glacio-fluvial and glacial outwash origin. Within any area rapid changes in sediment grain-size and aquifer thickness can occur. West of the Gloucester fault, ground water quality is generally acceptable. East of the fault, saline water may be encountered in the overburden aquifer in the vicinity of Ramsayville and Carlsbad Springs and in the aquifers north of the bedrock escarpment which parallels the Ottawa River. Other sporadic occurrences of salty and/or sulphurous water have been reported.

1 Areas where wells are likely to produce up to 100 gpm or greater from the bedrock. Areas are based on the predication that up to 200 feet of the Nepean sandstone aquifer can be penetrated within a depth interval of 500 feet. Sporadic occurrences of sulphurous water are reported throughout the area, particularly in the southeastern portion of the Township of Osgoode.

REGIONAL MUNICIPALITY BOUNDARY

TOWNSHIP BOUNDARY

GREEN-BELT BOUNDARY

NOTES

The probable yield indicated for each area represents the production of water that can be expected from individual wells based on geology and short- and long-term pumping tests and may not necessarily represent long-term yields which would be dependent on the rate of recharge to the aquifers from precipitation. The boundaries of the areas are approximate. A transition from low- to high-yield conditions or vice versa can be anticipated near the boundaries of the areas.

Theoretical yields of wells are highly variable in any area and it may be possible to develop wells of larger than the indicated probable yield. However, the majority of wells in any area are within the given probable yield classification.

Sources of Information:

Probable well yield by A.A. Sobanski, 1969

Well information from water well records on file with the Ontario Water Resources Commission

BASE MAP DERIVED FROM 1:50,000 NATIONAL TOPOGRAPHIC SERIES

ONTARIO WATER RESOURCES COMMISSION

REGIONAL MUNICIPALITY of OTTAWA - CARLETON GROUND WATER SURVEY

PROBABLE WELL YIELD

Scale 1:100,000 or 1.58 Miles to 1 Inch

Miles

Kilometres

DATE	DRAWN BY	DRAWING NO.
DEC. 17, 1969	A.A. Sobanski — S.F. Sisson	2102 - 4

FIGURE — 6